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The Effect of NAFTA on Mexican Agricultural Exports to the United States: The Case of Coffee Beans, 1970-2003

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Since its implementation in 1994, NAFTA's impacts on trade have been extensively and positively evaluated at an aggregate level, but not so much at a regional or sectorial level. Through time series analysis, this paper studies NAFTA's impact on Mexican exports of coffee beans to the U. S. The study shows a NAFTA's positive, although short-lasting effect (for two-three years) on the studied variable, mainly because the international market of coffee beans used to function on a quota system, thus preventing Mexico from capitalizing (and furthering) on the comparative advantage derived from its location, close to the U.S. market.

I. Introduction

The North American Free Trade Agreement (NAFTA) sparked a strong debate in Mexico about the costs and benefits associated with trade liberalization even before it was implement in 1994. Ten years later, there are still mixed opinions about the impact of NAFTA on Mexican development. Leycegui (2000)[1], for instance, argues that "…for Mexico, it is the most

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[1] From the 'Presentation' by Arturo Fernandez.

important economic policy decision for the last fifty years…(since)…it would help this country to become more efficient in its productive processes and therefore more competitive, which at the end will mean greater wealth and opportunities for the Mexican population". Others believe that NAFTA has not only not been able to match the expectations in terms of growth of Mexican exports, but also that it has deepened regional and sectorial disparities in the country. It promotes development only in a few regions and sectors, making it hard for other regions and sectors to catch up. (Delgadillo, 2004; Corona, 2003).

In fact, a simple view of the evolution of Mexico's foreign trade since 1994 shows a significant growth of trade with the United States. As the data included in Table I shows, Mexico´s balance of trade with the United States improved. A deficit was turned into a surplus during the 1994-2003 period as the balance of trade grew consistently from U. S. dollars -3,145.4 million in 1994, to + 36,399.3 million in 2003.

However, when the abovementioned development of Mexico-U. S. agricultural trade is evaluated, it is clear that NAFTA's impact has not been so strong, nor has it been so beneficial for México. Table II shows that during the period 1993-1998, Mexico's agricultural balance of trade with the U.S. became positive only in 1995 (one year after the implementation of NAFTA), and even then Mexican imports have grown faster than exports.

This paper focuses on the analysis of the change in Mexican exports of coffee beans to the United States during the period 1970-2003, with the help of time series analysis. The main reasons for selecting coffee beans for this analysis are: 1) coffee beans traditionally have been the single most important agricultural product in terms of the aggregate value of Mexican exports of coffee beans to the U.S.; 2) up to 1989, the international market of coffee beans had operated through a quota system imposed on producers by International Agreements. This did not allow countries to benefit from the comparative advantages (in terms of cost of production) associated with location.[2] The paper has been divided into four sections. Section II includes a discussion of the recent changes in the aggregate value of Mexican exports of coffee beans and comments on the functioning of the international market for the product. In section III, three studies of the impact of NAFTA on Mexican coffee bean exports to the U. S. are discussed. This section also includes the description of the econometric model used in this paper. Section IV, concludes by presenting the final results of this study.

II. The International Market for Coffee Beans and the Mexican Exports to the United States

For a long period of time, the international market for coffee beans was guided by International Agreements between producers, which determined a quota system for exports from participating countries. In fact, prices and volume of exports of coffee beans have rarely been determined by the free play of market forces, as the instability of the market forces meant that in a free market the coffee bean prices would fluctuations wildly. According to Renard (1993), the chief aim of the International Coffee Organization behind regulating the market through a quota system was to stabilize coffee beans prices. This was achieved by controlling the quantity of coffee beans supplied into the market, and for that, ICO used different indicators in different Agreements.[3]

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[2] In 1997, when Mexican agricultural exports to the U. S. amounted to U.S. dollars 3,388.5, exports of coffee beans to that country amounted to U. S. dollars 557.7 million, representing around 16.5% of the total, followed by fresh (and refrigerated) tomatoes, which amounted to U.S. dollars 519.4 million, or 15.3% of the total, and by malt liquor (beer), with U.S. dollars 402.4 million, or 11.9% of the total. (Cerro, 2000: 416).

[3] The International Coffee Agreements (ICA) grouped producers into four types, according to four varieties of coffee beans: Colombian softs, other softs (where Mexico is included), non-washed arabica, and robusta.

By the second semester of 1987, the then current International Coffee Agreement (which had been signed in 1983) was suspended. With the market now functioning freely, coffee beans prices went down and there was a significant drop in the value of exports, and even though the members of the ICO decided to extend the Agreement for one more year, it was abandoned completely by the second semester of 1989.

After the International Coffee Agreement was abandoned, the producer countries released their product surpluses into market, and the price of coffee beans dropped dramatically. According to Renad (1999), fell to 1.10 U.S. dollars per pound by June of 1989, and further to 0.70 U.S. dollars per pound by October of that year. This price was much below than that estimated by the producers after the agreement had been abandoned.. Prices continued to fall between 1989 and 1993 with coffee prices reaching their lowest level in 1992[4]

A. Mexican Exports of Coffee Beans to the United States

According to the International Coffee Organization, Mexico has traditionally occupied fourth to sixth place in the list of the most important producers of coffee beans in the world, with its exports representing 5% to 6% of world output.[5] Most of the coffee beans produced in Mexico are exported, and most of those exports are to the U. S. The data included in Table III, show that total annual Mexican exports averaged around 200 000 tons during the period 1975-1999, and that also on the average, around 75% of those exports have gone to the United States of America.[6]

III. Analysis of the Impact of NAFTA on Mexican Exports

There are at least three studies of the impact of NAFTA on Mexican exports relevant to this paper. Malaga, Williams and Fuller (2001) tried to identify the impact of NAFTA on the Mexican exports of five agricultural products to the United States; Garces (2001) focused at a more general level by considering total Mexican exports to the U. S.; Ramirez (2004) estimated the impact by using a type of model used by Garces, but at a more disaggregated level.

A. The Malaga, Williams and Fuller Model

The main objective of the Malaga, Williams and Fuller (2001) study was to measure the effect of the liberalization of trade and economic growth on U.S.-Mexico trade, through the analysis of supply, demand, exports and imports of the following five fresh vegetables: tomatoes, onions, cucumbers, squash and bell peppers.

The authors considered four factors (namely, growth rate of real wages, the level of productivity of technology, per capita income, and cyclical movements of the exchange rate between the Mexican peso and the U. S. dollar) related to different levels of economic development in Mexico and the United States, that affect the foreign trade of agricultural products in general, and of fresh vegetables, in particular. Thus, the model tests the behavior of

[4] At such low prices, many countries abandoned the production of coffee beans, since the current price did not cover costs. Moreover, the scaffold for the functioning of the International Coffee Organisation had been the public Institutes located within the exporting countries; for Mexico, it was the Instituto Mexicano del Café. After the breaking down of the International Coffee Agreement, such Institutes had no reason to exist and therefore they were dismantled.

[5] The most important producers of coffee beans at the world level are Brasil, with 30%, Colombia with 13%, Indonesia with 8% and México with 4% of the total exports. The most important importers of the product are the European Community with 44%, the United States with 24%, and Japan with 7% of the total. (ICO, 2004).

[6] It is important to notice that the atypical years both for total exports and for exports to the United States were 1988 (when the lowest figures were reached) and 1989 (when the highest figures were reached). As it was seen before, this was a direct consequence of the breaking down of ICA.

the demand and supply functions for the five vegetables in both countries, to determine the differential impacts of the four aforementioned economic indicators . (Please see Appendix 1 for the specification of the model)

One of the main results of this study is that economic growth is more important than NAFTA in explaining future changes in the foreign trade of the products considered. The authors found that NAFTA would be responsible only for changes in future U. S. imports of bell peppers. Moreover, they concluded that for the 1993-1996 period, the devaluation of the Mexican peso was the main factor responsible for the growth of U.S. imports of the five vegetables studied. They also found that the respective U.S. and Mexican rates of production (yield) influence the U.S. imports of tomatoes, squash and onions more than NAFTA. They also found that though changes in real income and/or real wage rates, have less impact on U.S. imports than that of the rate of growth in production, changes in real wage rates still have a more significant impact than NAFTA.

B. The Garces Model

Garces (2001) studied the behavior of Mexican total exports and imports within the NAFTA framework between 1980 and 2000. He stresses the impact of institutional changes in foreign trade, by analyzing imports and exports separately.[7]

The author estimated export demand functions, and he found a very stable demand when it is a function of the index of U. S. industrial production and also a function of the real exchange rate. In general terms, the author found that the U. S. economic activity has impacted the Mexican balance of trade most significantly. Also, he found that the depreciation of the Mexican peso increased trade between the two countries and contributed to Mexico's surplus of balance of trade with U.S.

C. The Ramirez Model

Ramirez (2004) chiefly uses the Garcés model but he disaggregates it to try to explain the behavior of Mexican textile exports during the 90's.[8]

The author calculated short-term elasticities and concluded that Mexico's textile exports are most sensitive to changes in the index of U. S. industrial production. He also found that the aggregate value of China's textile exports to the U.S. affect the Mexican textile exports to the U. S. Ramirez also concludes that there is an important inverse relationship between the index for the real industrial wage rate in Mexico (as compared with China's) and the value of Mexican textile exports.[9]

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[7] For the case of exports, Garces (2001) uses the following model:

(1) $\mathbf{Log\ (x_t) = ß_0 + ß_1 log(ivpi_t) + ß_2 log(tcr_t) + u_t}$

where: (x_t), indicate mexican exports; ($ivpi_t$), is an index for the value of mexican industrial production; (tcr_t), is the real exchange rate.

[8] The model used by Ramirez (2004) is as follows:

(2) $\mathbf{X_t = ß0 + ß1 ivpi_t + ß2 tcr_t + ß3 xchina_t + ß4 istex_t + ß5 ismanch_t + u_t}$

where: X_t indicate Mexico's textile exports; $ivpi_t$ is an index for the U. S. industrial production; tcr_t is the real exchange (Mexican peso-U. S. dollar) rate; $xchina_t$ indicate China's textile exports to the U. S.; $istex_t$ is an index for wages in the Mexican textile sector; $ismanch_t$ is the index of wages in China's manufacturing industrial sector.

[9] The author created some *dummy* variables for controlling NAFTA's effects, but they resulted non-significant.

D. The Model for the Study of Mexican Exports of Coffee Beans to the United States

The model estimated in this paper is similar to the disaggregated one used by Ramirez (2004).[10] We tried to analyze the effect of NAFTA on Mexican foreign trade by studying the behavior of the Mexican exports of coffee beans (in kilograms) to the U. S., thus testing the hypothesis that trade liberalization is beneficial to all participating countries. The tested model was as follows:

(3) $$\mathbf{Ln(x) = ß0 + ß1ln(p) + ß2ln(\%cm) + ß3ln(gpc) + ß4ln(ypc) + ß5ln(tcr) + ß6ln(ismM) + ß7ln(xcomp) + ß8Dummy(ptlcan) + ß9Dummy(tlcan) + ß10Dummy(dtlcan) + ß11Dummy(ai)}$$

where: *ln*, refers to the first difference in the natural logarithm of the relevant variables; (x), indicates Mexican exports of coffee beans to the U. S. (kg); (p), shows the international price of coffee beans of the "other softs" group; (%cm), is the proportion represented by the industrialization of coffee beans in the total Mexican manufacturing sector; (gpc), refers to per capita expenditures on coffee in the U. S; (ypc), indicates U. S. per capita income; (tcr), refers to the real exchange rate peso/dollar; (ismM), indicates the index of real industrial wages in Mexico; (xcomp), indicates the exports of coffee beans to the U. S. by other competitors (kg); Dummy(ptlcan), shows a *dummy* variable indicating a year prior to NAFTA, which equals 1 in 1993 or before; Dummy(tlcan), indicates the year of NAFTA, and it equals 1 for 1994; Dummy(dtlcan), indicates a year after NAFTA, and equals 1 in 1995 or after; Dummy(ai), indicates the year of the dissolution of the Fourth International Coffee Agreement, and equals 1 in 1989.

This model was tested for the period 1970-2003. The data for the exports of coffee beans by Mexico and by other competitors are expressed in annual growth rates. The international price of "other softs" coffee beans is also expressed as an annual rate of growth. The value of the manufacture of coffee beans is also expressed as a percentage of the aggregate value of the Mexican manufacturing sector. The U.S. per capita expenditure on coffee is also expressed as an annual rate of growth, as are the U. S. per capita income, the index for manufacturing real wages in Mexico, and exports from competitors.

There were three *dummy* variables included into the model to take into account the impact of NAFTA. The variable dummy(ptlcan) was introduced to analyze the effect of the anticipated implementation of NAFTA; variable dummy(tlcan) was introduced to see if there were any changes in the level of exports of coffee beans from one year on after the implementation of NAFTA; and variable dummy(dtlcan) was introduced to detect any lags on the impact of NAFTA upon exports of coffee beans.[11]

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[10] Is it important to mention that the most appropriate model to study agricultural products is the one used by Malaga, Williams and Fuller. Nonetheless, such a model can not be used for the case of coffee beans simply because the U. S. does not cultivate coffee beans and therefore it does not have a supply function, which is fundamental to that model.

[11] The main data used for the volume of exports of coffee beans came from the Mexican annual foreign trade statistics (INEGI, 2004). The international price series for 'other softs' came from Renard (1993) for years 1970 to 1984; for years 1985 to 2003, they came from www.ico.org (the web page for the International Coffee Organisation). All data referring to the participation of the industrialization of coffee in Mexican manufacturing came from the *Banco de Información Económica* (Economic Information Database), BIE, prepared by INEGI (www.inegi.gob.mx). Also the data series for the index of industrial wage rates came from the BIE. The data on per capita consumption of coffee in the U. S. came from the World Bank (www.worldbank.org). Data for the real exchange rate came from the web page of the *Banco de Mexico*, the Mexican central bank (www.banxico.org.mx).

E. Tests for Unitary Roots

As is it well known, a time series model has to be subjected to tests of integration in order to classify the series as with a stationary tendency, or with stationary differences.

The integration tests applied in the paper are included in Table IV, and they are the Augmented Dickey-Fuller test, the Phillips-Perron test and also the GLSDF test proposed by Elliot, *et. al.* (1996). Those (and other) are used jointly to corroborate the presence of unitary roots in the time series of data.

The first part of Table IV, shows the test for unitary roots for both the dependent and the independent variables. One can see from the data shown in Table IV, that Mexican exports of coffee beans is the only variable for which the unitary roots hypothesis is rejected, with a 5% level of confidence, by using the augmented Dickey-Fuller test; that is, the variance and the mean are constant through time. Thus, for all the other level series the unitary roots hypothesis is accepted and therefore one can proceed to calculating differences.

The Phillips-Perron test shows similar results as the variable 'Mexican exports of coffee beans' is the only one for which the unitary roots hypothesis is rejected.

The second part of Table IV shows the results from the calculation of the first differences in the time series. In this case, the only two variables for which the unitary roots hypothesis is accepted are the series for the real exchange rate and the series for the index of the real wage rate within the coffee manufacturing sector. For the rest of the series of data, the hypothesis of unitary roots on first differences is rejected. This is shown in the coefficients as their absolute value is below the critical value, both in the Dickey-Fuller test and in the Phillips-Perron test. It is important at this time to mention that most coefficients are statistically significant at the 1% confidence level.

The third (last) part of Table IV shows the results from the analysis of second differences. The second differences show that the unitary roots hypothesis is rejected at a significance level of 1% for all variables.

F. Cointegration Analysis

A cointegration analysis was performed to see if a long-run relationship existed among the variables. The econometric analysis consisted of the consideration of a vector on *k* non-stationary variables which form a cointegrating system, which could subsequently be interpreted as a long-run demand function for Mexican exports of coffee beans, which itself depends on *k-1* variables.

In this section, the demand for the Mexican exports of coffee beans is estimated as a linear function of: the international price of 'other softs'; the rate of participation (share) of the coffee industry within the Mexican manufacturing sector; the per capita expenditure on coffee in the U. S; the rate of per capita income in the U. S; the real exchange rate; the real wage rate in the coffee sub sector of Mexican manufacturing, and; the rate of exports of coffee beans to the U. S. by other competitors.

In order to test the cointegration levels among the variables included in the analysis, the variables in the model were subjected to the Johansen (1988) Test. Thus, a maximum

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The data for the exports of coffee beans from other competitors came from the web page of the United Nations Food and Agriculture Organisation (FAO) (www.fao.org).

likelihood analysis was run for the variables in the system. The corresponding results are shown in Table V.

The first part of Table V includes the values of the Max-lambda statistics and the path for the sequential hypothesis of no-cointegration vectors, at least one vector and three vectors at the most.

For the first hypothesis, the Max-lambda statistic of 165.55 exceeds the critical value of 52, which leads one to reject the hypothesis of no cointegration. Thus, the second hypothesis has to be evaluated and it is also rejected because the value of the Max-lambda coefficient is larger than the critical value. The value of the Max-lambda coefficient of the third hypothesis is below the critical level and is therefore, not rejected. Thus, it is concluded that there are two vectors of cointegration; that is, there exist two long-run equilibrium relationships among the variables considered in the system. Therefore, the coefficients can be interpreted as long-run elasticities.

The second part of Table V includes the normalized cointegration coefficients (ß-coefficients) and the adjustment of the α-coefficients for the two cointegration vectors of the variables in the system. Only the first vector will be taken as a reference in order to facilitate the interpretation of the long-run relationships among the variables. The coefficients have the correct signs and therefore the estimates from this first vector suggest the following long-run demand for Mexican exports of coffee beans:

(4) $$\mathbf{Ln(x) = c + 35.949ln(p) + 1.18ln(\%cm) - 31.226ln(gpc) - 34.002ln(ypc) - -4.973ln(tcr) + 10.357ln(ismM) + 32.963ln(xcomp)}$$

The third part of Table V includes the results from the weak exogeneity test. This test is used to contrast the null hypothesis that one or more variables in the VAR are not included in the cointegration relationships. Thus, they indicate that none of the variables included in the cointegration system can be eliminated from the long-run relationships.

IV. General Results from the Study

Table VI shows the expected impact of the independent variables (which will be discussed in this section) on the Mexican exports of coffee beans to the U. S. (MECBUS).

One can start with the variable that shows the difference in the natural logarithm of the international price of 'other softs'. The results indicate that if the rate of growth of such international price increases by one percent, the rate of growth of MECBUS will decrease by 5.14 percent.

The next variable indicates that if the growth rate of the participation of the coffee industry in Mexican manufacturing increases by one percent, the rate of growth of MECBUS will increase by 0.72 percent.

Also, if the rate of growth of U. S. per capita expenditures on coffee goes up by one percent, the growth rate of MECBUS will also go up by 4.978 percent.

However, if the rate of growth of the exports from other competitors increases by one percent, the rate of growth of MECBUS will decrease by 3.187 percent.

In the case of the *dummy* variables introduced into the model to account for the effects of NAFTA and the dissolution of the International Coffee Agreement, the three *dummies* gave statistically significant results. Thus, the variable that measures the previous effect of NAFTA is related to an increase in the rate of growth in MECBUS by 0.339 percent. Similarly, the variable that measures the effect of the presence of NAFTA on the rate of growth in MECBUS shows an increase of 1.057 percent with respect to the period previous to NAFTA. However,

the variable which measures the lag effect of NAFTA on the rate of growth of MECBUS shows a decrease of 1.38 percent.

Variables such as the rate of growth in U. S per capita income; the rate of growth of the real exchange rate, and the rate of growth in the index of real wages for the Mexican manufacturing sector, all display inverse relationships with the growth rate of MECBUS. But, these results were not statistically significant.

Chow test was applied to the regression (shown in Table VI) in order to see if either NAFTA or any other event caused a structural change in the coefficients of the long-run relationships between the behavior of MECBUS and the rest of the variables included in the analysis. The result was an estimated value of 0.686 for the Chow statistic, which was smaller than the critical value, thus indicating that NAFTA did not modify the value of the coefficients in the long-run relationships.

Last, Table VII includes the results from the model of the Vector of the Correction of Errors (VEC), which shows the short-run relationships between the change in the rate of growth of MECBUS and the independent variables. Those results indicate that an increase in the growth rate (first difference) of the share of coffee beans within the Mexican manufacturing sector for the second previous period will have a negative impact on MECBUS of around 1.3%, and that an increase in the growth rate of the real wage rate index for the Mexican manufacturing sector for t-2 will have a 1.741% positive impact on MECBUS.

V. Final Comments

On the basis of the results from the analysis of the Mexican exports of coffee beans to the United States, one can say that, contrary to what Malaga, Williams y Fuller (2001), Garces (2001) or Ramirez (2004) found, that in the case of coffee beans, NAFTA had a positive impact on Mexican exports to the United States of America. However, such an effect lasted only a very short period of time.

Such a short run positive effect is more likely to have resulted from the peculiar characteristics of the functioning of the international market for coffee beans. Usually, this market subjected the coffee producers to a system of quotas and rarely allowed for the market to determine the price and volume in international trade. In such working terms, the international market simply did not allow for countries such as Mexico, to capitalize on the comparative advantage it enjoyed due to its proximity with one of the most important importers of coffee beans.

With the dissolution of the ICA in 1989 and the implementation of NAFTA in 1994, Mexico had an opportunity to use its comparative advantage derived from being geographically close to the United States. However, this did not last for very long. After two-three years, NAFTA's positive impact on the Mexican exports of coffee beans to the U.S.A. disappeared. By then, the international price of coffee beans, the exports of Mexico's competitors to the U. S. and the behavior of the U. S. economy had a more significant impact on MECBUS.

In short, combining the results from this study with those from other previous studies, including the one by Malaga, Williams and Fuller (2001), it can be concluded that although the NAFTA has played an important role in increasing Mexican exports to the U. S. at an aggregate level that has not been the case for other agricultural products. For products such as coffee beans or vegetables, which are supposed to be important sources of foreign exchange, NAFTA has had little or no positive impact on Mexican exports to the U. S.

One has to recognize that internal factors in Mexico are responsible for the behavior of Mexico's agricultural exports sector, as there has not been a well defined policy for promoting productivity and competitiveness in the primary sector for the last few decades in the country

(Cerro, 2000). However, as 'coffee beans' is one of the few products, where Mexican producers do not face competition from the U. S. producers, it is evident that NAFTA will not be able to address the problem of the lack of competitiveness of the Mexican agricultural sector – contrary to one of the chief arguments supporting the establishment of NAFTA. .[12] Thus, while NAFTA cannot be blamed for the fate of Mexican agricultural exports to the U. S., Leycegui's assertion that NAFTA would make the Mexican producers more efficient (and hence more competitive) cannot be substantiated for the agricultural sector.

[12] Other products which are not produced by American farmers include sugar cane and many tropical fruits.

REFERENCES

Cerro, José y Félix Vélez (2000). "La agricultura a cinco años de vigencia del Tratado de Libre Comercio de América Latina del Norte", en Leycegui, Beatriz y Rafael Fernández de Castro (coordinadores). *¿Socios naturales? Cinco años del Tratado de Libre Comercio de América del Norte*. México, D. F.: Instituto Tecnológico Autónomo de México/Miguel Ángel Porrúa.

Delgadillo Macías, Javier, Felipe Torres Torres y José Gasca Zamora (2004). "Reconfiguración territorial y Tratado de Libre Comercio del Norte de América. Un balance a diez años de aplicación en México". *Regiones y Desarrollo Sustentable*. Año IV, núm. 6 (January-June).

Díaz, S. (1993). "Auge y crisis en la cafeticultura Mexicana". Ponencia al Simposium Latinoamericano 'Modernización Tecnológica, Cambio Social y Crisis Cafetalera'. Heredia, Costa Rica, 13 al 16 de Julio de 1993. Universidad Nacional de Costa Rica e Instituto Costarricense del Café.

Elliot, G., T. Rothenberg, and J. H. Stock. (1996). Efficient test for an autoregressive unit root. Econometrica 64: 813-836.

Garces, Daniel (2001). *Was NAFTA Behind the Mexican Export Boom 1991-2000?*

Gobierno de México (1993). *Texto oficial. Tratado de Libre Comercio de América del Norte*. México, D. F.: Editorial Porrúa.

INEGI (1998), *Estadísticas Históricas del Comercio Exterior de México*. Aguascalientes, Ags.: Instituto Nacional de Estadística, Geografía e Informática (INEGI).

Gómez, M. (2001). "La actividad cafetalera en México 1989-200 y perspectivas para el café mexicano". Tesis de licenciatura en economía. Universidad Nacional Autónoma de México.

Gujarati, D. (1999). *Econometría* (tercera edición). México, D. F.: McGraw-Hill.

Johansen,S. (1988), "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control* 12, 231-254.

Leycegui, Beatriz y Rafael Fernández de Castro (coordinadores) (2000). *¿Socios naturales? Cinco años del Tratado de Libre Comercio de América del Norte*. México, D. F.: Instituto Tecnológico Autónomo de México/Miguel Ángel Porrúa.

Malaga, Jaime E., Gary W. Williams y Stephen W. Fuller (2001). "US-Mexico fresh vegetable trade: the effects of trade liberalization and economic growth". *Agricultural Economics,* 26 (45-55)

Ramírez Hernández, Oliver (2004). “Explicando el boom de las exportaciones textiles mexicanas de los 90’s. Un análisis de series de tiempo”. Tesis de licenciatura en economía. Universidad de las Américas-Puebla. Puebla, Pue.

Renard, M. (1993). *La comercialización internacional del café*. Chapingo, Méx.: Universidad Autónoma de Chapingo.

Santoyo, H. (1994). *Sistema agroindustrial del café en México: diagnóstico, problemática y alternativas*. Chapingo, Méx.: Universidad Autónoma de Chapingo.

Villarreal, R. (1979). *Economía internacional. Lecturas.* México, D. F.: Fondo de Cultura Económica.

www.banxico.org.mx; www.fao.org; www.ico.org; www.inegi.gob.mx (2004);

www.worldbank.org

Table I

Mexico's Balance of Trade, 1993-2003. (millions of U.S. dollars)[a]

Country	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003/p
Total	-18,528.7	7,087.5	6,535.0	428.6	7,913.5	-5,583.6	-8,003.0	-9,953.6	-8,136.0	-200.5
North America	-3,283.2	13,057.4	13,466.4	12,370.6	8,894.3	14,568.0	19,487.6	25,364.4	34,731.5	6,009.2
U. S. A.	-3,145.4	12,444.2	13,037.9	12,182.6	9,665.6	15,125.5	20,151.1	26,529.7	36,399.3	6,140.7
Canada	-137.8	613.1	428.4	188.1	-771.3	-557.5	-663.5	-1,165.3	-667.7	-131.4
ALADI	-826.3	1,827.1	2,033.0	1,715.8	653.6	-470.4	-1,127.3	-1,716.4	-2,864.1	-631.2
Central America	409.9	633.3	716.8	945.2	1,099.6	980.3	1,077.8	1,120.5	861.5	92.0
European Union	-6,252.2	-3,378.7	-4,230.7	-5,929.7	-7,810.1	-7,540.1	-9,165.0	-10,832.9	-11,223.0	1,794.1
European Free Trade Association	-360.7	210.6	-85.0	-258.3	-372.1	-321.1	-265.0	-450.1	-407.1	-37.3
NICS	-2,509.9	-1,326.0	-1,672.7	-2,801.2	-3,397.1	-4,411.3	-6,195.1	-7,392.2	-9,349.4	-1,173.8
Japan	-3,783.0	-2,972.8	-2,738.7	-3,177.3	-3,685.8	-4,307.0	-5,535.1	-7,465.1	-8,877.3	-1,171.1
Rest of the World	-1,483.3	-658.9	-437.2	-1,468.4	-2,000.4	-2,430.3	-3,526.1	-4,819.7	-5,270.6	-440.8

[a] Annual data; p = preliminary (january-february)
Source: Delgadillo (2004: 143).

Table II

Mexico's Agricultural Balance of Trade with the United States, 1993-1998. (Millions of U.S. dollars)

Concept	1993	1994	1995	1996	1997	1998	Annual Growth (%)[a]
Agricultural Balance	- 82.0	- 776.0	1,065.1	- 1,045.4	- 409.6	- 638.0	-
Agricultural Exports	2,472.3	2,544.6	3,539.7	3,119.8	3,388.5	3,570.4	7.62
Agricultural Imports	2,554.3	3,320.6	2,474.7	4,165.2	3,798.1	4,208.4	10.5

[a] Annual growth for period 1993-1998 = (value in 1998/value in 1993)^2
Source: Cerro (2000: 414).

Table III

Exports of Mexican Coffee Beans to the U. S. A., 1970-2003

Year	Total Exports (Kgs) (a)	Exports to U:S:A. (kgs) (b)	% c= b/a
1970	83,031,192	64,149,899	77.26
1971	102,010,612	77,211,831	75.69
1972	119,233,602	86,599,369	72.63
1973	128,149,008	96,034,863	74.94
1974	135,081,775	99.312,118	73.52
1975	143,101,110	102,782,650	71.82
1976	167,788,336	117,246,857	69.88
1977	106,744,471	80,821,096	75.71
1978	114,007,611	88,522,932	77.65
1979	174,942,772	117,150,267	66.96
1980	164,375,098	120,011,593	73.01
1981	156,180,535	124,125,534	79.47
1982	160,100,759	123,535,817	77.16
1983	219,505,015	135,222,956	61.60
1984	174,036,271	112,546,948	64.67
1985	227,274,105	164,356,756	72.32
1986	208,344,349	145,118,749	69.65
1987	223,046,481	166,257,362	74.54
1988	64,358,915	49,060,421	76.23
1989	271,891,141	233,046,596	85.71
1990	209,127,935	178,987,249	85.59
1991	221,401,980	180,142,564	81.36
1992	204,588,849	181,302,694	88.62
1993	195,838,211	173,172,685	88.43
1994	178,076,885	131,593,347	73.90
1995	188,023,380	149,915,644	79.73
1996	263,867,657	198,469,727	75.21
1997	243,953,254	170,985,329	70.90
1998	226,755,621	138,701,785	61.17
1999	242,157,571	179,192,033	73.99
2000	176,247,455	120,623,760	68.44
2001	116,822,987	78,862,815	66.37
2002	113,918,857	80,403,926	70.58
2003	73,674,536	51,380,622	69.74

Source: Calculated with data from INEGI (2004).

Table IV

Stationarity and Unitary Roots Tests

LEVELS I(0)					
Variable	**ADF**		**PPERRON**		**DFGLS**
	A	**B**	**A**	**B**	**B**
Mexican Exports of Coffee Beans in Kgs. (exp)	-3.636**	-1.684	-24.62***	-22.103**	-1.971
International price of coffee beans (precio)	-1.894	-1.943	-6.901	-6.465	-1.812
Share of coffee beans in mexican manufactures (share)	-1.517	-1.303	-3.904	-4.348	-1.299
USA per capita expenditures in coffee (gasto_pc)	-2.205	-1.927	-8.820	-8.072	-1.815
USA per capita income (ingreso_pc)	-1.385	-2.172	-2.360	-2.754	-1.746
Real exchange rate (tcr)	-0.931	-1.949	-5.378	-3.789	-2.044
Wage rate index within the coffee sector of mexican manufacturing (indiceW)	0.025	-0.791	-2.404	-1.050	-1.339
Competitors' exports of coffee beans (exp_comp)	-2.584	-2.345	-12.149	-12.688	-2.464
FIRST DIFFERENCES I(1)					
Mexican Exports of Coffee Beans in Kgs. (exp)	-9.850***	-6.068***	-43.78***	-47.86***	-5.979***
International price of coffee beans (precio)	-6.569***	-4.016**	-38.38***	-37.83***	-3.860***
Share of coffee beans in mexican manufactures (share)	-6.224 ***	-4.904***	-33.19***	-36.25 ***	-5.059***
USA per capita expenditures in coffee (gasto_pc)	-7.125***	-3.993**	-41.58***	-40.85***	-3.960***
USA per capita income (ingreso_pc)	-3.734**	-4.863***	-18.662**	-23.68***	-4.935 ***
Real exchange rate (tcr)	-2.785	-3.030	-11.936	-14.341	-3.032*
Wage rate index within the coffee sector of mexican manufacturing (indiceW)	-3.273*	-2.568	-14.707	-14.594	-2.236
Competitors' exports of coffee beans (exp_comp)	-6.813***	-5.370***	-32.67***	-37.88***	-5.129***
SECOND DIFFERENCES I(2)					
Mexican Exports of Coffee Beans in Kgs. (exp)	-12.718***	-7.919***	-46.94***	-50.40***	-7.942***
International price of coffee beans (precio)	-10.537***	-6.956***	-44.62***	-46.97***	-6.823***
Share of coffee beans in mexican manufactures (share)	-8.932***	-7.300***	-37.18***	-43.21***	-7.491***
USA per capita expenditures in coffee (gasto_pc)	-11.526***	-6.899***	-47.19***	-48.99***	-7.057***
USA per capita income (ingreso_pc)	-5.230***	-5.660***	-23.41***	-29.98***	-5.360***
Real exchange rate (tcr)	-5.490***	-5.935***	-24.37***	-31.94***	-6.107***
Wage rate index within the coffee sector of mexican manufacturing (indiceW)	-7.589***	-4.543***	-37.29***	-41.26***	-4.669***
Competitors' exports of coffee beans (exp_comp)	-9.286***	-7.100***	-39.21***	-44.16***	-6.874***

A= Intercept and tendency; B=Intercept, tendency and one lagg

*** Significant at 1%; ** Significant at 5%; * Significant at 10%

Source: Direct calculations

Table V

Maximum Likelihood Analysis for Mexican Exports of Coffee Beans, 1970-2003

(i) Cointegration Analysis			
Eigenvalues	0.993	0.96325	0.1499
Null Hypothesis	Ran.=0	Ran.<=1	Ran.<=2
Max-lambda	165.550	109.023	5.3575
Max-lambda critical value	52	46.45	40.3
Lambda trace	283.05	117.502	8.4792
Lambda trace critical value	165.58	131.7	102.14

(ii) Standardized Vector of Cointegration and Coefficients of Adjustment									
Variable		**exp**	**price**	**share**	**per capita Expend-iture**	**per capita income**	**tcr**	**indiceW**	**exp_comp**
Vec-tor 1	Standard-ized Vector of Cointegra-tion (Beta)	1	35.949	1.180	-31.226	-34.002	-4.973	10.357	32.963
	Coeffi-cients of Adjustment (Alfa)	-0.01	-0.001	-0.003	0.001	0.003	0.005	-0.003	-0.001
Vec-tor 2	Standard-ized Vector of Cointegra-tion (Beta)	0.100	1	0.030	-1.037	0.065	0.074	-0.114	0.746
	Coeffi-cients of Adjustment (Alfa)	-2.59	-0.399	0.440	0.394	-0.099	-0.759	0.266	-0.429

(iii) Exogeneity Test for a Given Variable							
Variable	**price**	**share**	**gasto_pc**	**ingreso_pc**	**tcr**	**indiceW**	**exp_comp**
Weak Exogeneity (Granger) chi-(1)	1.683	0.085	2.178	0.512	0.1338	0.017	0.037

P-values inside parentheses
*** Significant at 1%; ** Significant at 5%; * Significant at 10%
Source: Direct calculations

Table VI

Regressions for the Rate of Growth of Mexican Exports of Coffee Beans to the U.S.A.

Variable or Parameter	Differences in the Natural Logarithm (Mexican Exports of Coffe Beans in Kgs.)	Robust 't'
Differences in the natural logarithm (International price of coffee beans (precio))	-5.138	(3.67)**
Differences in the natural logarithm (Share of coffee beans in mexican manufactures (share))	0.72	(1.85)+
Differences in the natural logarithm of USA per capita expenditures in coffee (gasto_pc)	4.978	(3.59)**
Differences in the natural logarithm of USA per capita income (ingreso_pc)	-2.205	(1.32)
Differences in the natural logarithm of Real exchange rate (tcr)	-0.324	(1.22)
Differences in the natural logarithm of real wage rate index within the coffee sector of manufacturing (indiceW)	-0.1	(-0.21)
Differences in the natural logarithm o competitors' exports of coffee beans to the U. S. (exp_comp)	-3.187	(2.54)*
Dummy_previous (=1 from 1993 forward)	0.339	(2.06)+
Dummy_tlc (=1 from 1994 forward)	1.057	(1.86)+
Dummy_lagg (=1 from 1995 forward)	-1.38	(2.34)*
Dummy_acuerdos (=1 for years when an international quota agreement existed)	0.327	(1.75)+
Constant	0.099	(0.86)
Observations	33	
R-squared	0.73	
Chow Test	0.686	
Wald Test (dummy_tlc=0)	2.200	
Heteroscedasticity (White)	33	

*** Significant at 1%; ** Significant at 5%; * Significant at 10%

Source: Direct calculations

Table VII

Model Vector of Correction of Errors for Mexican Exports of Coffee Beans

Variable+	Δ Mexican Exports of Coffee Beans	Robust 't'
$Cexp_{-1}$[(i)]	0.035	0
$\Delta export^{(i)}_{t-1}$	0.1805	-0.592
$\Delta export^{(i)}_{t-2}$	0.767	-0.573
$\Delta precio_{t-1}$	5.847	-4.415
$\Delta precio_{t-2}$	6.999	-4.76
$\Delta share\_b\_manuf_{t-1}$	-0.321	-0.451
Δ $share\_b\_manuf_{t-2}$	-1.317	(0.475)***
$\Delta gasto\_pc_{t-1}$	-5.239	-4.342
Δ $gasto\_pc_{t-2}$	-7.56	-4.802
$\Delta ingreso\_pc_{t-1}$	2.78	-4.081
$\Delta ingreso\_pc_{t-2}$	1.899	-4.857
Δtcr_{t-1}	-0.516	-0.647
Δ tcr_{t-2}	0.432	-0.755
$\Delta indice\_salarial_{t-1}$	0.377	-1.153
Δ $indice\_salarial_{t-2}$	1.741	(0.884)*
$\Delta export\_competidores_{t-1}$	4.851	-3.687
Δ $export\_competidores_{t-2}$	6.973	-4.279
Rsquared	0.1544	
F-Statistic	8.463066	

+See Table VI for the english equivalences of the variables

[(i)] Cexp-1= ln_y - 35.949ln_p - 1.18ln_share + 31.226ln_gpc + 34.002ln_ypc + 4.973ln_tcr - 10.357ln_ismM - 32.963ln_xcomp

*** Significant at 1%; ** Significant at 5%; * Significant at 10%

Source: Direct calculations

Appendix 1

The Málaga, Williams and Fuller Model

The model consists of the following group of equations:

United States Supply of Vegetable i

(1) $\mathbf{USha_i = f\ (Usfp_{i,t-1},\ USha_{i,t-1},\ USlc)}$

(2) $\mathbf{USS_i = USy_i \times USha_i}$

Per Capita U.S. Demand for Vegetable i

(3) $\mathbf{USd_i = f\ (USrp_i,\ USrp_j,\ USI)}$

(4) $\mathbf{USfp_i = f\ (USrp_i)}$

Supply of the Mexican Exporting Sector of Vegetable i

(5) $\mathbf{MXXha_i = f\ (MXbp_{i,t-1},\ MXXha_{i,t-1},\ MXlc)}$

(6) $\mathbf{MXXS_i = MXXha_i \times MXXy_i}$

Supply of the Mexican Domestic Sector of Vegetable i

(7) $\mathbf{MXDha_i = f\ (MXbp_{i,t-1},\ MXDha_{i,t-1},\ MKlc)}$

(8) $\mathbf{MXDS_i = MXDha_i\ X\ MXDy_i}$

Per Capita Mexican Demand for Vegetable i

(9) $\mathbf{MSd_i = f\ (MXrp_i,\ MXrp_j,\ MXI)}$

(10) $\mathbf{MXrp_i = f\ (MXbp_i,\ RER)}$

Transmission Price for Vegetable i

(11) $\mathbf{MXbp_i = f\ (USrp_i,\ UST_i)}$

Market Liberalization Conditions of the Market in Mexico/U.S. for Vegetable i

(12) $\mathbf{USED_i = USd_i \times USPOP - USS_i - USMo_i - USX_i}$

(13) $\mathbf{MXES_i = MXXS_i + MXDS_i - MXd_i \times MXPOP}$

(14) $\mathbf{USED_i = MXES_i}$

where subscripts *i* y *j* refer to tomatoes, cucumbers, bell peppers, onions and squash. All variables are considered for period *t* or for period *t*-1:

USd_i: U.S. per capita demand; $USrp_i$: detail price in the U. S.; $USrp_j$: detail cross-price in the U. S; USI: per capita U. S. income;USPOP: U. S. population;$USha_i$: cultivated land (acres) In the U. S;$USfp_i$: own price in the U. S;USlc: labor cost in the U.S;USS_i: U. S. supply;USy_i: U. S. productivity;MXd_i: mexican per capita demand;$MXrp_i$: detail price in México;$MXrp_j$; detail cross-price in Mexico; MXI: per capita income in Mexico;MXD_i: mexican per capita demand for vegetable i; MXPOP: mexican population;$MXbp_i$: price at the Mexico-U. S. border;RER: real Exchange rate Peso/Dollar;$MXXha_i$: cultivated land in mexican exporting status (acres);MXlc: labor cost in México; $MXXS_i$: supply of the mexican exporting states;$MXXy_i$: productivity of mexican exporters;MXDhai: cultivated land for domestic demand in Mexico (acres);$MXDS_i$: mexican domestic supply;$MXDy_i$: mexican domestic productivity; USTi: real tariff in the U. S;USEDi: U.S. excess demand;USMoi: U. S. imports from other countries;USXi: U. S. exports;MXESi: Mexico's excess supply.